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SURGICAL INJURIES OF THE HEAD.[1]

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In this paper I shall confine my remarks mainly to one branch of the subject, namely, fractures of the skull, with effusion of blood between the dura mater and bone.

Case I. On the evening of September 10, 1876, William Atherton, a boy seven years of age, received a kick upon the right temple from a horse. When he was lifted from the ground, no visible signs of life were present, but after four or five minutes a slight general convulsion occurred, respiration was resumed, several cries were uttered, and partial consciousness returned. Questions were comprehended, and the lad was able to reply intelligently. Vomiting quickly came on, and in about forty minutes after the accident I found him in the following condition: He was very pale, flaccid, respiration easy, no puffing of the corners of the mouth or other apoplectic symptoms; pulse 58, soft and small. Pupils of both eyes enormously dilated and nearly insensible to light. There was no facial or other paralysis. When questioned he answered feebly and intelligently; when undisturbed he lay in a tranquil sleep. Blood had flowed freely from a wound in the right temple, but now had ceased. An examination revealed a contused compound fracture of the right parietal bone, with displacement of a fragment. When the patient was well etherized, I made an exploratory incision from the margin of the os frontis to a point half an inch above the ear, about four inches in length. The skull exposed, a contused wound on the lower anterior border of the right parietal bone was found, with comminution and displacement of some of the fragments. From this point, posteriorly crossing the upper border of the squamous portion of the temporal bone, was a fissure four inches in length, below which the temporal and lower margin of the parietal were depressed to the depth of half an inch, and firmly fixed. In fact, the depression corresponded in length to the horse's shoe, one calk having produced the contused wound, while the remaining portion depressed the base of the skull in

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the region already described. Fully exposing the skull as far as I had reason to suppose the fracture extended, I removed a triangular fragment, now shown attached to the photograph, which was immediately followed by a gush of blood to the amount of about four ounces by estimate. Five or six small, irregular, pointed fragments of the inner plate were removed, several of which were discovered some distance from the opening by means of a probe. The opening having been explored with the finger and the clots removed, the brain quickly refilled the place occupied by the effused blood, and it was now apparent that the hæmorrhage had proceeded from a rupture of the anterior branch of the middle meningeal artery. The depressed temporal and parietal bones being seized with a pair of forceps, with a strong hand, the symmetry of the right inferior portion of the skull was restored. There was a single vertical cut in the dura mater, about half an inch in length; further than this there was no apparent injury of this membrane. The meningeal artery soon ceased to bleed after the application of ice. In the early part of the operation the anterior temporal artery was cut, and a pair of bulldog forceps were fastened on and allowed to remain until the operation was closed; when removed, hæmorrhage did not recur. The wound was closed, the patient placed in bed, and ice-water compresses applied every fifteen minutes. As soon as the effects of the ether had passed, the patient regained his consciousness completely.

Observation clearly showed that a reduction of the temperature below a certain point caused a partial collapse, evinced by a small and feeble pulse, pallor of face, and sighing respiration. The pupils remained large for several days, as though under the influence of belladonna. Vomiting came on, and continued at regular intervals for four or five days. The action of the brain could be observed through the opening in the skull, and its violence was controlled by the use of bromide of potassium in solution thrown into the rectum at the rate of one half drachm every six hours. By means of this agent twelve or fourteen hours of calm sleep were obtained daily. The pulse and temperature after the first twelve hours were each about a hundred. The case went on to convalescence without accident. A single fact is worthy of record. The scalp wounds healed quickly, save one small opening the size of an ordinary probe, leading to a sac of no great dimensions, which was immediately contiguous to the cut in the dura mater, from which, as it seemed, the serum from the arachnoid escaped for two or three weeks. Not the slightest abnormal condition of the brain or nervous system exists as a sequel of the accident, so far as is known.

Case II. August 28, 1876, I was called to visit a lad eight years of age, who had received a wound in the left parietal region at its greatest convexity. The boy had fallen from a wagon, and the seat had struck his head, the injury being produced, as was supposed, by a bolt project-

ing beyond the nut. When first examined, I found a puffy tumor which seemed to contain fluid, also a slight contusion of the scalp. A digital examination convinced me that there was depressed bone. The lad was able to sit up, and even walked about without any inconvenience, answered questions readily, was impatient of interference, and cried out when the wound was examined. When not disturbed he wished to sleep, and desired to be let entirely alone. Under these circumstances I determined to explore the tumor. The patient being placed well under the influence of ether, I made a free incision to the bone, at the greatest diameter of the tumor. A large blood clot was turned out, and the cranium exposed. An oval fracture was revealed, measuring one and three fourths inches by one inch and a quarter. The margin was entirely broken away and pretty uniformly depressed, just the thickness of the skull. In the centre of this detached oval plate, at its greatest diameter, was a contused fracture, with comminution, the fragments being driven sharply in to the depth of about half an inch, the depression being the size of a finger's end. A linear fissure extended from the centre of the depression laterally to its margin, isolating the upper third; still another linear fissure extended from the depressed point downward to the margin of the greatest diameter, the lower section not being entirely separated. Carefully detaching a minute fragment with a sharp-pointed instrument, I was able to introduce the beak of a pair of narrow forceps, and to lift the upper section to its normal position. Immediately there was an abundant flow of blood, about two ounces by estimate. At the point of contusion were several fragments of the inner plate, also one or two some distance away, which were detected by means of a bent probe, drawn to the opening, and removed. The dura mater was intact, so far as could be seen, but separated extensively from the skull, having been dissected up by the hæmorrhage. The spiculæ, five or six in number, and clots being removed, I cut out of the free margin of the replaced fragment, with a pair of eating forceps, an opening large enough to retain a blade of my narrow forceps. From this opening I lifted the lower section into position. The throbbing brain immediately closed the cavity and expelled the blood remaining under the skull. I am not able to state whether the dura mater was entirely separated from both sections, but I am sure it was entirely free from the upper portion and for quite a distance around. When all hæmorrhage had ceased, the scalp was drawn together and retained in position, mainly by bandages. An opiate was given, cold compresses were applied to the region of the wound, and absolute rest was enjoined. For four days following there was but slight disturbance of the system; both pulse and temperature continued about normal. The external wound closed by first intention, and convalescence seemed established. The free use of bromide of potassium, either by mouth or rectum, both

quieted the throbbing of the cerebral mass and gave sleep. On the fifth day the lad had a severe rigor, pulse rose to 120, temperature to 102+°. He experienced pain in his head, and complained that it felt large. I gave calomel and chlorate of potash in small doses, frequently repeated, and applied a poultice to the whole affected side of his head. The wound was reopened to the dura mater, about a drachm of pus escaped, and all uncomfortable symptoms subsided in two or three days. About the eleventh day after the injury he escaped the vigilance of his mother, went to the door, took cold, and had a return of the same unfavorable symptoms, and in addition great thirst and profuse sweating; he also complained that pressure on the plantar surface of his feet gave great pain in his head. There was partial anæsthesia of both feet, but on pressure there was a sensation of "numbness and pricking;" the same pricking pain extended to the lumbar region, where it was severe; thence to the head, in the region of the wound. I once more opened the wound by a probe, reapplied a poultice, which was followed by hot fomentations of infusion of hops, gave the calomel and chlorate of potash, well comminuted with sugar, in small and repeated doses, — the plan which I usually adopt in meningitis, — and in a short time convalescence became fully established.

Case III. A few years since I was called to a neighboring town to visit a young man who fell from the high beams of a barn, a distance of about eighteen feet, and struck his head upon a plank floor. The patient was in a state of profound coma; a loud call was unheeded, nor could his sleep be disturbed by any ordinary means. Respiration was slow, without stertor or puffing of the corners of the mouth. There was no voluntary motion, no facial paralysis, no hæmorrhage from the ear or nose. The symptoms indicated a violent concussion. On the right parietal boss was observed a not very prominent tumor, with effusion into the cellular tissue in the immediate region. I could discover no fracture or indication of depression. As the symptoms were imminent, and I was not able to make a satisfactory diagnosis, I determined to explore the tumor. On making an incision to the bone, I discovered a linear fracture, which I traced anteriorly to the os frontis, and posteriorly as far as I thought best to follow it. At the greatest convexity of the parietal bone was a comminution hardly more than a fourth of an inch in diameter. The minute fragments were scarcely depressed, and seemed impacted. With care and patience I succeeded in displacing a fragment the size of a pin's head, which proved the key to the position, and the remaining minute fragments being detached and removed, the opening in the inner plate was observed to be much larger. In my endeavors to extract a fragment, I lifted the whole side of the head, showing that the fracture must have extended half-way or more around the vault. A free opening to the dura mater having thus been

made, and the opening cleared of clots, a continuous stream of blood flowed from the wound, amounting to eight or ten ounces by estimate. The hæmorrhage continued for some hours, threatening a fatal result. The probe indicated an extensive separation of the dura mater, which seemed intact. I had the head placed on the injured side, to facilitate the escape of fluids, and after some hours the hæmorrhage ceased, consciousness returned, the patient made a good recovery, and no permanent injury was observed.

In this case the symptoms of concussion masked those of compression. The lucid interval which marks the subsidence of concussion and disappears on progressive pressure, the pathognomonic symptom of hæmorrhage, was wanting here. The opening, although small, proved sufficient for all purposes, and the shock and danger of trephining were avoided.

The results of external violence to the head depend much upon the thickness, elasticity, and density of the skull. Professor Gross speaks of one in his possession, averaging half an inch in thickness, hard as ivory, and with scarcely a trace of a suture. Such a skull could hardly be crushed by any force which might be brought to bear upon it. I have one of an adult, only three sixteenths of an inch in thickness, and with no perceptible diploë. Others are hardly a line in thickness, and exceedingly brittle, although this property is not peculiar to thin skulls.

The elasticity of the skull can be easily demonstrated by throwing a fresh one upon the floor and observing the rebound. Owing to this physical condition we have local contusions of the brain without fracture of the skull. As an illustration I will cite the case of a woman found dead from violence. The commonwealth requested me to make an autopsy. I found upon the scalp seven contused wounds, pretty evenly distributed over the sides and vault of the head. In no place was the skull exposed, nor did the injuries seem severe. Upon removing the calvarium I observed seven well-defined patches of extravasated blood under the arachnoid, each exactly corresponding to a wound upon the scalp, but larger in extent. The gyral spaces were filled with clotted blood, the convolutions were contused, and the pia mater more or less broken up. In this case the blow was transferred directly to the brain, producing fatal lesions without fracture of the skull, and but slight injury to the hairy scalp. Death evidently had not been *immediate*, but how long the victim had lived after the injuries could not be known.

At the same time and place, and probably by the same person, animated by the same diabolical purpose, and with the same instrument, a sister came to her death by blows. All the bones in the right side and base of the skull were extensively fractured, and some of them were much displaced; yet hardly a trace of injury was observed in the sub-

stance of the brain. The force of the blows had been spent upon the skull alone. The appearances indicated that death was instantaneous. I attribute the contrast in the traumatic lesions in these two cases to the opposite properties of the skulls.

The night following the battle of Antietam, the regiment to which I was attached lay down to sleep in the road. A squadron of cavalry, unaware of our position, charged over us. A sleeping soldier was struck near the vertex by the shoe of a horse, and received a punctured wound, in which the bone was depressed, just the size and shape of the calk. As it was a well-marked contused fracture, although signs of compression were wanting, it was thought best to operate, and I applied the trephine. The inner plate was badly splintered, and a single fragment was detected by a probe and removed from between the dura mater and bone, a point a short distance from the seat of injury. There was no hæmorrhage, nor were the membranes or other tissues wounded. The wound was closed and the patient removed to the general hospital in a comfortable condition. I have been unable to trace the subsequent history of the case, but the records at the adjutant-general's office show no death from wounds of the head in that regiment during that period.

In the cases of contused fractures cited, there has been one condition uniformly present, namely: the inner table has been broken into a number of small fragments, most of them with sharp edges, and in all the cases under my observation one or more pieces have been found a short distance from the seat of injury. This is a practical fact of great value. What then becomes of these fragments if allowed to remain? Professor Gross states that they *never* become encysted. A bullet or other foreign body may become encysted, especially if it has passed the cortical surface of the brain; but fragments resting upon the membranes of the brain are always a source of danger, and often result in fatal meningeal disease. "The lymph effused around spiculæ of bone is incapable of organization, and frequently acts as a foreign body, likely to bring on a train of symptoms ending in death," or, what some might think worse, confirmed epilepsy. For a hundred years and more, authors have generally attributed the much more extensive splintering of the inner table to its greater brittleness; some to the direction of the force and to a variety of other reasons, none of which is the true one. Mr. W. F. Teevan, of London, was the first to demonstrate that it occurred not from the brittleness of the inner plate or any of the reasons usually assigned, but in obedience to a well-known physical law, namely, "that fractures always begin in the line of extension and not that of compression." He showed that violence applied to the inner surface of the skull may produce fracture of the external table only, without any lesion whatever of the inner table; and the same degree of violence applied to the external surface may produce fracture of the internal table

only. This is illustrated by the familiar instance of the cracking of a thin sheet of ice under pressure. Numerous fissures are seen on the under surface, while none are observed on the proximal surface; if its continuity is destroyed the fissure always commences on the distal surface. Mr. Teevan further illustrates by the fact "that in bending a stick across the knee it begins to break at a point opposite to the spot where the knee is applied." In the bent stick the atoms along the proximal curve, at which pressure is made, are brought nearer together or compressed, while the atoms along the distal curve are extended or separated; the rent is finally made *exactly opposite* the point where the greatest pressure is exerted. Thus, in a fracture of the skull by a blow from the outside, the fracture will always first start on the inner side, and, as in the cracking ice, may not extend completely through the wall, thus producing the rare result of a fracture of one plate only, and that of the plate opposite the spot where the blow was struck, whether it was from within or from without. Mr. Teevan states that he has no difficulty in producing, by slight blows with a hammer on the outer or inner surface of the calvaria, fissures or stellated fractures of either table at will.

In cases of suspected fracture of the inner table only, Stromeyer advises that the part be explored by carefully percussing the cranium with a silver probe. As the probe enters the region of fracture the sound given is of a somewhat higher pitch.

Dr. Otis, in his Surgical History of the War, states that of twenty known cases of fracture of the inner table only, but one survived, and in this instance there was necrosis of the outer table, which released the fragments within, the whole process of cure having been completed in a little more than six months.

You will observe that the three cases first cited were all well-marked instances of compression from extravasation of blood within the cranium and between the dura mater and bone. In the first, it was demonstrated that the hæmorrhage proceeded from the anterior branch of the middle meningeal artery. The fragment extracted had a sharp edge, which was in immediate contact with the artery when the scalp was removed, and no doubt was the cause of the arterial hæmorrhage. The feeble, slow, and soft pulse, great pallor of countenance, and imperfect respiration are the usual prelude to death by compression, which is generally sudden. Mr. Hutchinson records a similar case of a lad who, while under consideration, with the same class of symptoms, suddenly and without tremor or convulsion died. In the case of the young man who had fallen from the high beams of the barn, death was imminent, as I believe, from hæmorrhage of the posterior branch of the middle meningeal artery, although it is possible that the blood might have been poured out from the numerous small arteries which pass

from the dura mater to the skull. Some two hours had elapsed after the accident before the operation.

In Case II. we have a double fracture. First came the blow from the projecting bolt, making the ordinary contused wound, "the size of a finger's end," with several sharp fragments of the inner plate, one of which doubtless wounded a small branch of the middle meningeal artery; then came the violence from the larger surface, crushing in a plate of bone, the size and shape of which has already been described. In this case we have the slight compression of the displaced bone, which, although quite large, yet in the earlier history of the wound produced no symptoms whatever. Locomotion was not impaired, and there was no disturbance of the functions of the brain. It was only after about an hour that he grew peevish, with evident symptoms of approaching coma, indicating the somewhat gradual extravasation then going on between the dura mater and bone. The amount of blood (about two ounces) found under the depressed bone has been known in like cases to cause death in about four hours. At the moment of the operation bleeding was still going on, and had there been no relief it might have produced death in even less time.

The cases cited above show the necessity of prompt surgical interference in traumatic hæmorrhage within the skull.

We may now properly inquire what becomes of blood effused under these circumstances if not removed. Prescott Hewett states that small quantities are sometimes absorbed. Larger quantities produce death by squeezing the brain, thus forcing out the arachnoid fluid, leaving the membranes dry and the functions of the brain suspended from anæmia or from inflammatory processes in the encephalon. Dr. S. W. Gross says he has failed, after careful search, to find the history of a single case of effusion between the dura mater and bone where the changes in effused blood have taken the same course as like effusions in other parts of the body. The coagulum usually becomes putrid, thus producing irremediable inflammation of the brain and membranes. Dr. Gross still further states that in fourteen cases in military practice which he had collected, two of which were his own, where the trephine or other operative interference was employed, with the result of fifty-seven per cent. of mortality, he could not ascribe death in a single instance to the operation. The main objection urged against operative interference is the danger from exposure of the dura mater to the air, and consequent inflammatory products; but should this occur there is far more hope of controlling it than when there is no opening for the escape of the secretions. In Case II. well-marked inflammation of the membranes occurred twice, with purulent secretion, but was quickly relieved by ordinary means.

My own observation leads me to the conclusion that in a large per-

centage of contused wounds of the skull the trephine is wholly unnecessary, and I believe it is seldom that minute fragments may not be separated by an awl, chisel, or some other instrument which the peculiarities of the case will suggest at the moment, and the trephine be avoided.

Dr. Holston, U. S. V., strongly recommends the use of a chisel with a projecting blunt tooth, which protects the membranes from the edge of the chisel. The sharp edge will cut cleaner and with less irritation than the saw, the teeth of which tear the tissues and give almost as much shock for every tooth as the chisel and mallet do at every blow.

If we turn to the text-books for aid in making a differential diagnosis in traumatic injuries of the head, we shall be led to great confusion and perplexity. Whatever the statements and conclusions of any one writer may be, they are sure to be contradicted, and the opposite plan advised by another of equal eminence. These varying opinions among the great lights of surgery lead us to the humiliating conclusion that we have as yet no established science in this branch of surgery.

Huguenin, in an article in Ziemssen's Cyclopædia, nearly discards all operative interference. He admits the propriety of trephining in cases of hæmorrhage from the arteria meningea media, when there is no doubt; that is, "when symptoms of pressure first appear some time after the injury, and steadily increase up to a certain pitch. The symptoms (unilateral paresis) and the nature of the injury must at all events confirm the diagnosis." In the three cases I have presented there was no unilateral paresis, — in one, profound insensibility from the moment of injury, — nor is this symptom, which the author regards as pathognomonic, present in a large percentage of recorded cases.

The orthodox doctrine of unilateral paresis, that the paralysis is always on the opposite side from the lesion, is well combated by Brown-Séquard, who states that he has collected more than two hundred cases where the paralysis is on the same side as the brain lesion.

If we review the cases so clearly and forcibly narrated by Hutchinson, one of the best recent writers upon this subject, we shall find from his own showing that in every instance he waited for an autopsy to confirm his opinion that an operation was required. In two cases this distinguished surgeon finally determined to trephine; but unfortunately both patients died before the operation was begun. In one of his lectures he makes this remarkable statement: "The modern annals of surgery do not, as far as I am aware, contain any cases in which life has been saved by trephining for this state of things," that is, for effusion of blood between bone and dura mater. Very different are the conclusions of Dr. Gross, who, reviewing the fourteen cases before alluded to, writes thus: "The teachings, therefore, of these cases lead to the conclusion that, when compression of the brain is dependent

upon the extravasation of blood between the dura mater and the skull, the latter must be opened in order that the clot may be turned out, and that to be of any avail the operation should be practiced at once, since when stupor, convulsions, and hemiplegia arise, after the case has had time to run through the different stages of inflammation, they are due to irremediable suppurative inflammation of the pia mater and arachnoid, or to abscess of the brain, or to a combination of both these conditions."

Here I believe is the secret of the failure of the operation in many cases: it is too late. While the surgeon waits for more urgent symptoms, he waits till Death steps in before him.

SCARLATINA VERSUS DISINFECTION.

BY JOHN L. SULLIVAN, M. D., MALDEN.

THE following history illustrates the difficulty of extinguishing the contagion of scarlet fever, as well as that of determining the period when the disease ceases to be communicable by the patient or his surroundings: —

On November 1, 1876, a girl, aged six years, one of a family of three children, during the temporary absence of her elder sister and brother, was seized with scarlatina anginosa. The case terminated favorably after running a severe course. On the 28th the child seemed perfectly well. Desquamation had ceased; her skin had been cleansed as thoroughly as it could be by repeated ablutions of warm water and soap, and the liberal use of vinegar and carbolic acid solution.

In the mean time the absentees had held no communication with home, and, as a further precaution for their safety, it was deemed advisable to try to disinfect the premises, and possibly to expel the contagion before their return. This was carefully done under my immediate supervision. One after another all the apartments of the dwelling, including the halls, were filled with fumes of burning sulphur, as dense as could be generated by the rapid combustion of large quantities of that substance moistened with alcohol, and in this state were kept closed for several hours. Doors and windows were then thrown wide open and the air allowed to sweep through the house until the sulphurous smell had been dissipated. Beds, blankets, and other woolen fabrics that had been worn or used by the patient or her attendants were spread out in one of the closed rooms and exposed for a long time to the action of the sulphurous vapor and afterwards for more than twenty-four hours to that of the out-door air, at a season when the weather was boisterous. All washable articles were "scalded out" in boiling water, washed in strong soap-suds, and dried on the clothes-line in an